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Toxic shock

PCBs on Ile Ste. Hélène

by Megan Durnford

IN 1967, *Man And His World* overflowed with tourists. Twenty years later, it's a toxic waste dump.

Eighteen transformers filled with PCBs (polychlorinated biphenyls) are stored under the Concordia bridge, which connects St. Helen's Island to the Island of Montréal. They are not an isolated phenomenon. In Canada there are 6500 tonnes of concentrated PCB liquids currently in storage awaiting disposal.

PCBs have not always been considered dangerous waste. In 1929, when they were first produced in the United States, PCBs were acclaimed by the electricity industry. Most large industrial transformers are filled with a dielectric which acts as an insulator and a heat exchanging fluid. Before 1929, mineral oil was used. This was potentially hazardous, because a power surge could provoke its ignition.

However, PCB compounds are stable and exhibit low flammability, low electrical conductivity, and low vapour pressure. PCB fluids are sometimes called askarels, which is a generic name for synthetic, non-explosive, electrical insulating material. These fluids

seemed safe — at least safer than the mineral oil — and so Canada imported 40,000 tonnes from the Monsanto company in the United States.

Unfortunately, now that they are known to be hazardous chemicals, 16,000 of the 40,000 tonnes are circulating in our environment.

Until they were recognized as dangerous, PCBs were disposed of without precautions. They entered the environment mainly as runoff from roads on which PCB contaminated oils had been sprayed as a dust-suppressant. PCB products discarded in land-fill sites also entered the water supply. In addition, incomplete combustion (at temperatures lower than 1200 degrees Celsius) caused release of PCBs into the atmosphere by combustion gases. And during a fire, PCB compounds are oxidized to furans and dioxins which are much more acutely toxic than the original PCB compounds.

The first instance of toxic human exposure to PCBs occurred in Japan. In 1968, PCBs and other chlorinated hydrocarbons leaked from a heat exchanger in a food processing plant, heavily contaminating rice oil. The first effect was chloracne resulting from skin contact and ingestion. Also, numbness and swelling in the joints and menstrual changes were reported. Most of the short term symptoms have now disappeared but it is still difficult to

determine what the long term effects will be.

In rat experiments, PCBs produce liver neoplasms and carcinomas when given in the order of 10 mg per kg body weight. The mutagenic (change in gene or genes of an organism) and teratogenic (malformation during fetal development) potential of PCBs is variable in rats.

According to Environment Canada, food contamination by PCBs has also occurred in this country. There are now official limits to PCB concentration in food: from 0.1 mg/g in eggs to 2mg/g in fish.

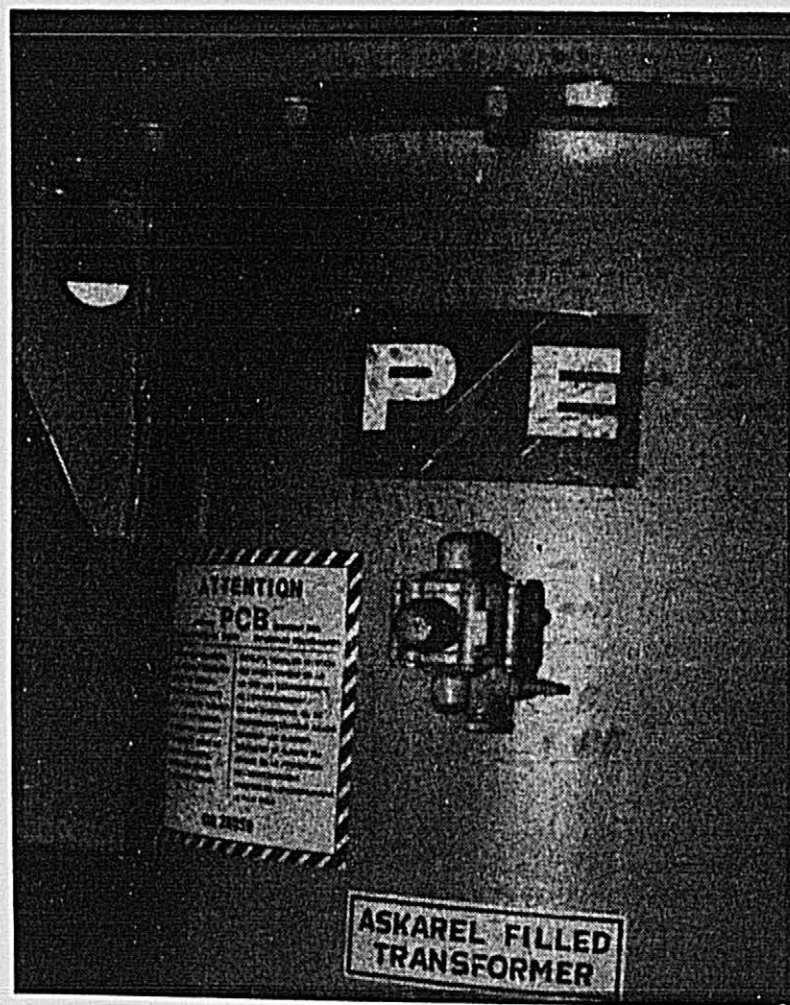
In one instance of contamination, PCB-filled electromagnets accidentally leaked over grain conveyor belts. The event received little media attention because the grain was identified immediately and properly destroyed.

But the Kenora, Ontario PCB spill in 1985 was widely publicized. This accident left 100 gallons of PCB fluid coating the Trans Canada Highway. The guilty transformer sprang a leak in a cooling fan on its way from Varennes (Hydro-Québec's research center) to a storage site in Alberta. The transformer had to be moved subsequent to cleanup after a fire at the research center.

The incident generated a lot of questions and the end result was an amendment to the Transportation of Dangerous Goods Act on May 28, 1986. The new legislation regulates all road and rail PCB transportation activities in Canada and describes specific handling and packaging for PCBs.

The Québec government is currently engaged in a ten year phase-out program for PCBs. Within three years, PCBs must be removed from public service sectors and the food industry. In five years PCBs must be removed from industry when they represent a threat to workers' health. All other PCBs must be eliminated within ten years.

Although Environment Canada is keeping an inventory of equipment containing PCBs, keeping track of it all is difficult. "There are 2500 transformers in Quebec," said Alain Bernier, acting director for



Man and his world, transformer containing PCBs

environmental contamination, "but it is not possible to know which are in use and which are in storage at any given time." When PCB contaminated equipment is in storage it is closely controlled by federal inspectors.

The eighteen transformers under the Concordia bridge are sitting in pans which "can contain the amount of liquid present in the transformers," said André Blain, from the Building and Supply department of the City of Montréal.

According to Blain, the transformers are so safe that the city has no intention of moving them to another storage site. Besides, the two main commercial sites at Shawinigan and Saint Basile Le Grand have been full for almost two years.

To comply with regulations, these transformers will be moved in about two years to be incinerated. At present there are no incineration facilities in Canada. Since 1980 the United States has prohibited Canadian export of PCBs to their three incinerators. Shipping the waste overseas would be far too expensive. Ironically the technology for

cement kilns used in Norway and Germany was developed in Canada.

The first Canadian incinerator will open in a few months near Swanshill, Alberta. The first incinerator in Québec will be constructed by the Sanivan group at Senneterre in Northwestern Québec. Following public hearings and an environmental impact study, Sanivan will set up a storage facility and an incinerator designed to destroy 99.9999% of PCB compounds at 1200 degrees Celsius.

Québec disposal regulations stipulate that there may not be any dangerous residues after incineration. Jean Marc Lalancette, a chemist working with Hydro-Québec, designed a system whereby metallic sodium is added to the combustion process to prevent the formation of dioxins and furans. The only residues left after this process are carbon and hydrogen dust and salt (NaCl).

While some PCB contaminated equipment is being destroyed, scientists are discovering substitutes for PCBs used in dielectric fluids.

continued on page 2



What's under wraps these days...

Daily Photo — Ron Fleishman

the ENVIRONMENT

INSIDE

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The oracle speaks, radon gas, and mental illness

Page 6-7

In the environment...

Ozone, plutonium, acid rain, and other nasties

And that's all folks.

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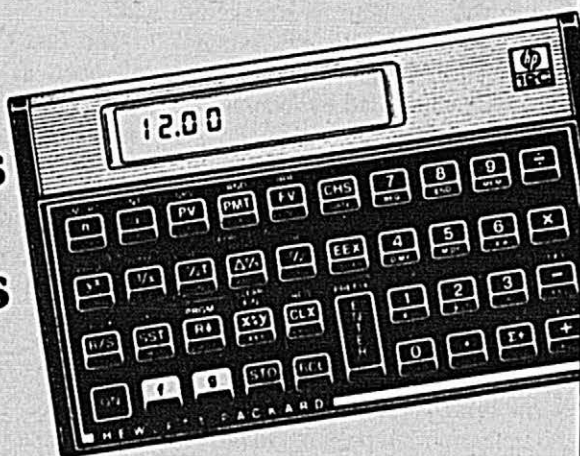
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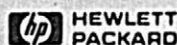
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...PCB

continued from page 1

New transformers are either dry (mainly small transformers) or filled with silicone fluids or aliphatic hydrocarbons.

PCBs were once considered to be

miraculous products. Their drawbacks have since overcome their advantages. How many chemicals currently in widespread use could reproduce the PCB story?

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The McGill Model U.N. Society first general meeting at 16h00 in Leacock 429.

McGill Outing Club general meeting, 19h30, Stewart Biology S1/4.

Bangladesh Indigenous Peoples' Support Committee, general meeting, 18h00, at the CDAS, 3715 Peel, Seminar Room.

Crown Investment Society conference on investment funds by Talvest Fund Management and T.A.L. Investment Counsel, 16h30, Bronfman 301.

McGill Film Society presents *Destiny* directed by Fritz Lang, 19h30 in the FDA auditorium.

McGill Squash Club first club night, 19h00, Currie Gym squash courts.

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Schizophrénie, gène des familles

Isabelle Montpetit

Parmi les tabous de notre société, la maladie mentale occupe une place importante. Une bonne partie de la population en souffre un jour ou l'autre et pourtant, l'évocation du problème provoque souvent un malaise. Quant aux causes et aux traitements de ces maladies, ils sont loin d'être parfaitement connus.

À l'Hôpital Louis-Hyppolite Lafontaine, ce symbole du confinement des malades mentaux, la Fondation des Maladies Mentales avait invité Albert Jacquard à donner une conférence sur le thème *Hérédité, génétique et maladie mentale*, le 21 septembre dernier.

Généticien reconnu, vulgarisateur de grand talent et philosophe qui donne à réfléchir sur ce qu'il appelle notre humanité, Albert Jacquard a présenté un modèle qui décrit la contribution de l'hérédité génétique à l'apparition de la schizophrénie. Il en a profité pour présenter sa conception de la complexité humaine et pour plaider en faveur de la tolérance et de la liberté afin que l'humanité puisse éviter le désastre de la guerre nucléaire.

En Europe occidentale et orientale, de même qu'en Amérique, la schizophrénie affecte 1% de la population. Cette maladie est décrite comme une psychose conduisant à une désagrégation mentale où les pensées et les sentiments sont ambivalents, le patient perd contact avec la réalité et se replie sur lui-même. On croit que cette maladie a une composante génétique puisque chez les frères et sœurs de schizophrènes, la propor-

tion de ceux qui en sont frappés monte à 8% (quoiqu'on hérite de sa famille de bien d'autre chose que les gènes).

Le modèle le plus simple en génétique est celui qui a donné naissance aux lois de Mendel. Il s'applique à des caractères qui sont déterminés entièrement par un seul gène. La couleur des petits pois se transmet de façon mendélienne. Par contre, les lois de Mendel ne réussissent pas à expliquer la transmission de la schizophrénie.

Avec l'approche probabiliste, au lieu de déterminer un rapport direct de causalité entre une combinaison de gènes (génotype) et un trait de caractère (phénotype), on évalue plutôt la probabilité d'avoir tel phénotype si on possède un génotype donné. On étudie aussi la façon dont les caractères se transmettent en déterminant la probabilité qu'un enfant reçoive de ses parents un certain génotype.

L'analyse des généalogies de schizophrènes avec l'approche probabiliste a suscité plusieurs pistes de travail. On a conçu des hypothèses impliquant 1, 2, ou 4 couples de gènes qui agiraient les uns sur les autres. On parle de couples de gènes puisque l'enfant reçoit une copie de chaque type de gène de chacun de ses parents. Pour chacune des hypothèses, on a déterminé la proportion des porteurs de chaque combinaison de gènes qui devaient être normaux, schizophrènes ou schizoides pour correspondre à la distribution de la maladie dans la population (i.e. 1% de schizophrènes, 8% de

PHENOTYPE	GENOTYPE		
	AA	Aa	aa
Normaux	100	90	35
Schizophrènes	0	10	40
Schizoides	0	0	25

Probabilité du phénotype

Tableau 1. Modèle probabiliste de la transmission de la schizophrénie.

schizophrènes chez les frères et sœurs de schizophrènes).

On a ensuite soumis chacune des hypothèses à un test mathématique de vraisemblance qui permet de déterminer la probabilité qu'un modèle représente la réalité. Après avoir soumis les trois modèles les plus vraisemblables à une simulation par ordinateur, on en a choisi un qui semblait meilleur que les autres.

D'après ce modèle, un seul couple de facteurs (A et a) contrôlerait la prédisposition à la schizophrénie. De plus, ce gène, s'il existe, ne ferait pas automatiquement un schizophrène de celui qui en est porteur (voir tableau 1).

En effet, seulement 25% de ceux qui auraient deux copies de ce gène (génotype aa) seraient effectivement schizophrènes, 40% schizoides et 25% normaux. Quant à ceux qui n'auraient qu'une copie du gène, seulement 10% d'entre eux seraient schizoides, 90% seraient normaux.

D'après Jacquard, l'être humain est si complexe qu'on ne pourra probablement jamais définir toutes les interactions qui causent la maladie, du moins pas de façon rigoureusement scientifique. En science, on peut élaborer des modèles qui décrivent des situations assez simples. Or, dans le cas de systèmes complexes, on n'arrive pas à connaître tous les paramètres et, en fait, le peu qu'on sait ne nous permet pas de cerner les phénomènes de façon rigoureuse. C'est pourquoi on doit raisonner en termes de probabilités.

En regardant ces chiffres, on s'aperçoit qu'on n'est pas forcément "taré" du fait d'être porteur de ce gène. En effet, puisque un quart de ceux qui ont le génotype aa seraient schizophrènes et que cela correspond à 1% de la population, il résulte que 4% d'entre nous seraient aa. Or la probabilité de recevoir 2 copies du même gène (i.e. 2 fois a, 4%) est égale au produit des fréquences de ces deux gènes dans la population. Il découle que 20% de la population (20% x 20% = 4%) serait porteuse de ce gène, soit une personne sur 5. On ne peut plus parler de familles tarées puisque le gène pourrait être présent dans des familles où personne ne présenterait de symptômes de schizophrénie ou de schizoidie.

Si ce modèle représente la réalité, on voit qu'en plus de la composante génétique, d'autres facteurs doivent influencer le développement de la maladie.

On sait que le système nerveux humain est extrêmement complexe: l'embryon met en place des centaines de milliers de neurones par minute à certaines périodes de son développement et le nouveau-né en possède quelques dizaines de milliards. De plus, à la naissance, le bébé n'a pas fini de fabriquer son cerveau: il lui reste à mettre en place jusqu'à un million de milliards de connexion (synapses) entre les neurones ainsi qu'une gaine de myéline qui permettra aux fibres nerveuses de fonctionner plus efficacement. Le développement du cerveau est sensible aux hormones, à l'alimentation, aux produits toxiques, au stress, etc. Il est concevable que ces facteurs environnementaux puissent aussi influencer

Il est vital que nous définissions les valeurs auxquelles nous attachons de l'importance: l'intégration des marginaux, des malades mentaux, par exemple et surtout la paix. Comme il le dit, la folie de l'accumulation des armes fait que l'humanité est aux prises avec une machine de mort dont personne n'a voulu. Paradoxalement, ce monstre devient si complexe et si puissant que les humains commencent à obéir à ses lois. On en vient à s'armer parce que le pays voisin l'a fait, par exemple.

D'après Jacquard, c'est notre talent pour la liberté que nous devons cultiver coûte que coûte si nous voulons continuer à vivre l'humanité.

The oracle speaks

by Kim Blasted

Every month, the *Daily Science Edition* brings you answers to some of the most puzzling, and often most self-evident, facts of life. The Oracle is always seeking new challenges, and any questions can be delivered to Dan Hogan or Paul White in the Daily office, Union B-03.

Why is it that antennas are different shapes? Some are straight, some are round and others are T-shaped, why is that?

Jonathan Freed
U3 Political Science.

To explain the reason behind each particular shape would require rather complex engineering mathematics. Basically, the goal of every receiving antenna is essentially identical: to catch its specific type of electromagnetic radiation with maximum efficiency and minimum interference.

The length of an antenna is determined by which portion of the electromagnetic spectrum it is supposed to receive. The electromagnetic spectrum is a continuous distribution of waves, includ-

ing among others, radio waves, UHF signals, visible light, X-rays, and gamma rays. Although they all travel at the same speed in empty space, each type of wave has a different length, ranging from 1000 kilometers to one ten millionth of a millimeter. An antenna must be of the same order of length as the wave it is trying to catch.

The main purpose of the shape of the antenna is to focus the waves. Parabolic and grid type antennas are common for this reason, although there are many variations.

The other factors which go into antenna design are complex and beyond the scope of this explanation, but it all boils down to a matter of efficiency. If you want to know more about getting the largest possible output from a small input, you'll have to study electrical engineering.

How does an automobile radar detector warn you of a police speed-trap?

Greg Moore
U2 English

These clever little machines, used by drivers to avoid inconven-

ient police speed traps, are similar in design, if not in use, to ordinary radios. Both instruments are designed to receive parts of the electromagnetic spectrum, which includes radio waves, radar waves, light, X-rays and many other forms of radiation.

Police radar guns used in speed traps emit radar waves. With the principle of the doppler effect, the waves are shifted to a different frequency when they bounce off the car. The radar gun determines the increment or decrement in frequency to determine the speed of the vehicle.

When the police radar gun emits these waves, most of them don't hit the car. They are 'broadcast' like radio waves, to the waiting receiver in another car—which is tuned, not to CKUT, but to the frequencies used by police radar. Instead of converting the electromagnetic waves to sound waves as a radio would, the detector simply signals the driver, who presumably slows down.

By the way these babies are illegal in Québec. If your curiosity is more than academic, be



Treaty plugs ozone?

by Paul A. White

Is the world becoming a global village? Are advances in communication inciting a trend of global thinking? Maybe. In recent years it has become increasingly commonplace to address issues on a global scale. From an environmentalist viewpoint, this is an attitude which is long overdue. It seems that environmental protection on a global scale is finally starting to take shape.

September 16, 1987 marks an historic date in global environmental protection. It was on this date that 24 nations from around the world signed a landmark treaty to control the production and consumption of chemicals (primarily chlorofluorocarbons or CFCs) that destroy the ozone layer of the earth's stratosphere. It is this layer of the atmosphere that shields the planet from excessive ultraviolet radiation emitted by the sun.

CFCs are industrial chemicals commonly used as refrigerant gases, as well as foaming agents in the production of plastics and rubber. They (along with chemicals called halons) are, for the most part, the chemicals which appear to be responsible for the destruction and depletion of the ozone layer.

According to McGill Geography Professor R.N. Drummond, the September treaty represented the first "global collective effort on environmental protection."

The treaty was signed during The Diplomatic Conference for the Protection of the Ozone held in Montréal from September 14-16. The conference met at the Headquarters of the International Civil Aviation Organization, with the support of the Government of Canada. McGill's Department of Meteorology worked along with the Canadian delegation to provide some of the background material for the conference.

Sixty-two countries participated in the conference, with 49 approving the final act and 24 signing the treaty itself. The most significant signatories were by far the United States, Japan and The Euro-

pean Economic Community (which signed as a collective), which are the major world producers of CFCs.

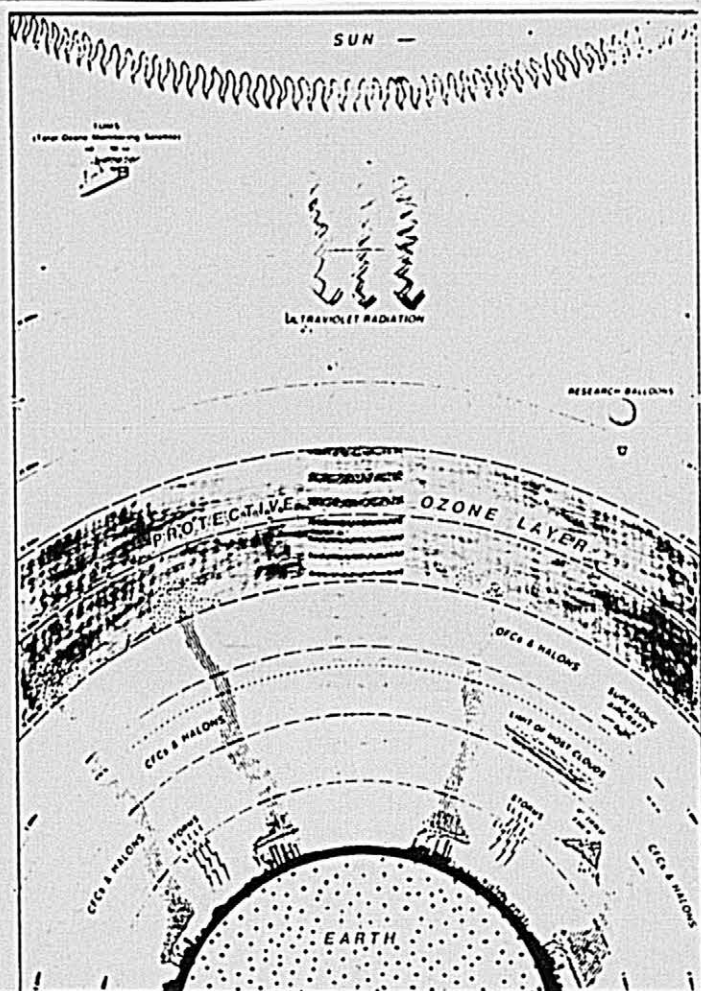
Many countries which did not sign, however, have the intention of signing in the near future, after their own governments have had a chance to look at the treaty more closely and coordinate it with their local environmental protection plans. Among these is the USSR.

The treaty commits its signatories to a 50% reduction of most ozone destroying chemicals (primarily the CFCs) by 1999. Restrictions will start with a freeze on the production of CFCs based on 1986 production levels, followed by an initial cut of 20% in the use of CFCs by 1994.

At first there was some concern over the fact that many developing countries did not sign. Yet the reduction of ozone depleting chemicals, "will still reach 50% even though many developing countries are not participating," stated Dr. Mostafa Tolba, executive director of the United Nations Environment Programme (UNEP). Tolba, who has been pushing for an ozone protection treaty for over 10 years, hopes that this marks the start of a series of global environmental protection treaties.

In order for the treaty to take effect, nations representing two-thirds of the world's consumption of ozone depleting chemicals will have to ratify it. This may prove to be extremely difficult as "each country has their own environmental legislation" and "many different facets of society are involved" in the ratification of such a treaty (i.e. industry, consumer, etc), said Drummond.

A number of countries, including Canada, would have to enact new legislation in order to enforce the treaty. Canada's Environment Minister Tom MacMillan stated that, "implementation of the treaty is under the jurisdiction of the federal government," and Canada's new Environmental Protection Act (which has gone into its second reading in parliament) will give the federal government the power to control ozone-destroying chemicals.



THREATS TO THE OZONE LAYER

What is the ozone anyway, and why is it so important? Ozone, a pungent, slightly bluish gas, is composed of three atoms of oxygen (usually denoted O_3). Molecular oxygen, which we breathe in the lower atmosphere is composed of two atoms of oxygen (usually denoted O_2).

About 90% of the earth's ozone is located in a frigid region of the atmosphere known as the stratosphere. Here it forms a layer of ozone some 20 km thick, lying between 15 and 50 km above the surface of the Earth, far above the limit of most clouds (at about 13000 meters).

Here in this outer region it helps protect the earth and the life forms which inhabit it, from the harmful effects of ultraviolet radiation coming from the sun. Excessive exposure to this radiation can cause serious damage to any living tissue, plant or animal.

One of the ways it acts is by inducing structural changes in DNA (the information storage molecule on which all life is based) known as *pyrimidine dimers*. These dimers can result in subsequent mutations to the message which the DNA encodes.

An increase in the penetration of ultraviolet light would cause an escalation in skin cancers (both malignant and non-malignant), eye cataracts, a reduction of the body's ability to cope with disease, as well as having a detrimental impact on aquatic organisms and plants.

The protective ozone layer in the atmosphere is usually formed when molecular oxygen (O_2) absorbs UV light, breaks down and reforms as ozone (O_3). It is the only gas in the atmosphere that is

capable of absorbing UV radiation from the sun.

The ozone layer is constantly being destroyed and replenished as part of a natural cycle. However, in about 1974 a group of scientists began to amass a body of evidence that suggested CFCs were involved in the destruction of the ozone layer. Initially, some scientists thought other natural phenomena such as normal emissions from volcanoes and forest fires, were involved in ozone destruction.

"Many things influence the quality of the atmosphere — both natural phenomena and chemical pollutants," said Drummond. As well, investigating the chemical reactions in the ozone involves employing a complex area of chemistry in which reactions can occur on the surface of ice crystals. Both these factors make it difficult to determine how CFCs are involved in ozone destruction.

Within the past few years, however, much of the scientific data gathered provides almost indisputable proof that chlorine atoms from CFCs are acting as a catalyst (an agent that promotes a chemical reaction) in the breakdown of the ozone layer.

Much of this recent work has been centred around the so-called *ozone hole* which seems to appear over the South Pole each September. Although world ozone levels have dropped by an estimated 3% to 7%, in the past several decades, south polar levels have been known to plunge by as much as 50%.

Scientists have been focussing much attention on the hole in the hope of conclusively proving that chlorine from CFCs is its cause.

"A lot of it is due to the depletion of the atmosphere's protective ozone layer. Chlorofluorocarbons (CFCs) can stay in the atmosphere for years and act as catalysts, states Drummond. "It's a gradual increase (of CFCs) towards the pole as a result of atmospheric circulation, gradually breaking up ozone to cause a problem."

Earlier this month, evidence linking chlorine to ozone destruction was published in the British journal *Nature*. The principal author of the study is a atmospheric physicist with the Scripps Institution of Oceanography in California. Although the study isn't final, it is strong evidence.

In any case, the reduction and consumption of CFCs marks a positive step towards the protection of the ozone layer, a strong advance towards global environmental responsibility.

Hopefully this is only the start of a series of international environmental protection treaties. Tolba at the conference stressed that other global environmental issues which require immediate action. Among the most important, UNEP will be addressing global warming, as the greenhouse effect, forest destruction and a

However, as Drummond points out, the problems are "global, but they can be solved by action on a local scale." Up to pollution from one country leads to problems on a global scale."



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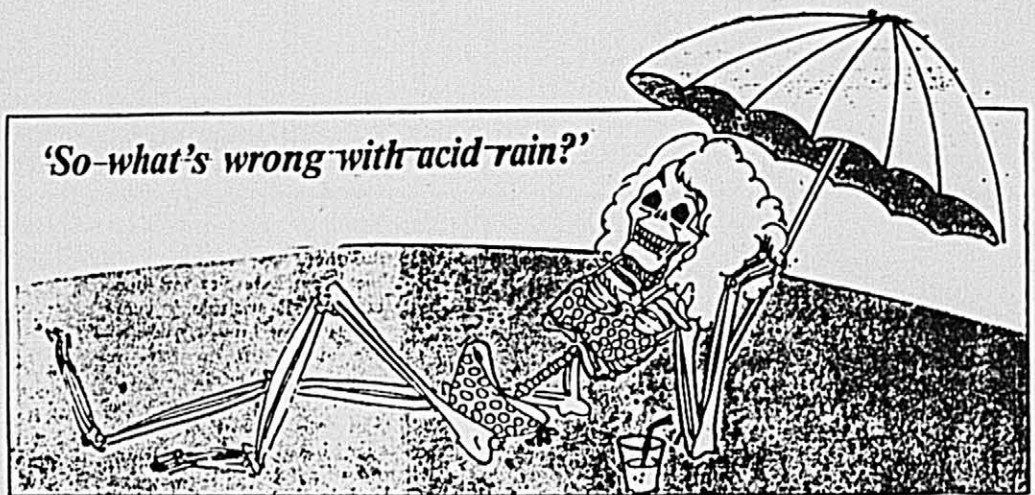
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Tad Homer-Dixon

Sizzling in the rain



by Mathew Copas

Recently, twenty four nations signed a pact to minimise the chemical damage to the earth's ozone layer. Environmentalists hope that the treaty will be the first in a series that seek to control the gradual destruction of the earth's environment through a host of man generated pollutants.

Nitrogen oxide and sulphur dioxide emission (which eventually causes acid rain) will likely have high priority in any future discussions. The political obstacles to reaching a global agreement would be formidable due to the financial cost in controlling emissions. If action is not taken though, the harm caused to the earth's environment will probably be long term and devastating.

The effects of sulphur dioxide and nitrogen oxide are wide ranging in their destructive powers. Lakes, forests, seas, and animals are all the victims of this human generated activity. Acid rain (the most publicized result of these chemical emissions) is of particular concern to Canada and the Scandinavian block of nations. We depend heavily for our economic well-being on the forest and fishing industries, both of which will, and likely already are, being adversely affected by acid deposition.

In Canada and the U.S., there have been numerous studies on the effects of sulphur dioxide emissions. Those in the

U.S. have been chiefly undertaken by the Environmental Protection Agency (EPA) and the National Academy of Sciences (NAS).

Last March, another study was released by the NAS, providing "the most conclusive evidence to date" that emissions of sulphur dioxide are causing environmental damage. It stated that, "the observed acidification of lakes cannot be explained by other disturbances.... Acid deposition is the most probable causal agent."



In one study Environment Canada accumulated acid deposition samples from between 500 and 1000 lakes in eastern Canada. Based on these statistics, figures were established for the overall death of lakes. It is currently estimated that there are as many as fourteen thousand acidified lakes, and this number could climb to

forty thousand within the next few years without U.S. co-operation.

Studies have also been done on the health effects in southern Ontario and have demonstrated that, "The levels of fine particles, average sulphate, and the maximum daily ozone were significantly associated with a decrement in the lung function of children."

The evidence that favors sulphur dioxide emission controls is mounting. The Canadian government is realizing that action must be taken, but the Americans are not. The problem in dealing with the American government is always the same. The evidence provided is in relative degrees, varying from suggestive to "the most conclusive to date", and is therefore considered insufficient.

In June of 1986, President Reagan received a special Canada/U.S. envoy and his reaction to their findings was, as expected, cool. He said that the report was a "step forward" and would be "studied carefully." That line seems to have become the latest 'double talk' for delaying action.

In the same year the influential Lewis/Davis report was released in the U.S. and reflected the government's opinion that scientific evidence was insufficient to justify "punitive control."

As politically persuasive as such reports are, it is difficult not to be skeptical of them. North and south of the border the scientific consensus is that sulphur dioxide emissions are acidifying lakes. At one point Reagan suggested that naturally occurring phenomena, such as birds defecating, were responsible for acid rain. It is that kind of argument that proponents of sulphur dioxide emission control are battling.

In the most recent joint Canada/U.S. report on acid deposition (released February of '87) the American position was unchanged. The Canadian consultants backed large scale clean-up but, once again, the Americans disagreed. It is regrettable, but likely that the U.S. policy towards acid rain will not change for several years. There is now bi-partisan consensus in the U.S. favoring control of sulphur dioxide emissions but the large federal deficit will discourage control of them in the near future.

According to Claude Gauthier, a program engineer with Environment Canada, "It's a political question rather than a scientific one."

It is estimated that sulphur dioxide emissions should be reduced by fifty percent (on both sides of the border) in order that sensitive eco-systems in the lakes not be destroyed. In the last two years Canada has initiated control of emissions in the hope that the American government will follow suit.

There is no doubt that reducing emissions is costly. The figures involved for a clean-up in the U.S. are difficult to estimate, but a Canada-U.S. envoy proposed that \$5 billion would be necessary to develop demonstration projects. Current technology (using wet sweepers on smokestacks) is costly and inefficient. It also creates waste that in itself poses an environmental threat.

In Canada's seven eastern provinces an agreement has been reached whereby sulphur dioxide emissions will be reduced by fifty percent by 1994. Most of the pollution comes from smelters which each year emit millions of tons of sulphur dioxide. According to Monsieur Gauthier, the Canadian clean-up will be on two scales.



"The first part of the program is to reduce sulphur dioxide emissions which are responsible for two thirds of acid rain. The remaining one third of acid rain is caused by nitrogen oxide emission. The second part of the program deals with nitrogen oxide emission from cars... The federal government has regulated the allowable emission for new cars, which had applied since September, 1987."

Thus, progress is being made, but it is not enough. It is clear that in dealing with the American government (both Congress and the President), the lowest common denominator is the federal deficit. "Canada is currently embarking on a publicity campaign in the U.S. which it hopes will alert the American public to the increasing danger of acid deposition."

For the first time in the world's history, human activity has the ability to manipulate the earth's environment on a massive scale. Responsible action is an urgent matter.

One hopes that with continued pressure on governments, they will begin to treat the earth's environment with the respect it is due. Until now, political expediency (at least south of the border) has dictated that scientific evidence is, well, for the birds.

ernobyl in the sky?

by Dan Hogan

Cargo planes laden with hundreds of pounds of radioactive plutonium could soon be flying over Canada's high arctic, possibly posing grave environmental and security hazards.

The flights would be part of a recent bilateral negotiation between the U.S. and Japan. At present, Japan receives U.S.-supplied uranium fuel for use in its nuclear reactors. The spent fuel from these reactors can in turn be reprocessed in order to recover plutonium which can also be used as reactor fuel. However, according to American-Japanese supply agreements, any such reprocessing must be approved by the United States.

Japan as yet has no adequate reprocessing facilities of its own, so it must ship its nuclear waste to France and Britain for plutonium extraction. Transporting the plutonium back to Japan by sea has been both costly and prone to terrorist hijacking. What Japan now seeks is U.S.

approval to fly the plutonium from Europe to Japan via Alaska.

The main critic of the plan is Tad Homer-Dixon, a MacArthur fellow at Massachusetts Institute of Technology, specializing in defence and arms control. Last week, Homer-Dixon outlined some of the potential dangers of the plan at a lecture, sponsored by McGill Student Pugwash, entitled *Plutonium Over Canada: A case study in science and society issues*.

"Although the probability of a single isolated crash is quite low, the environmental impact could be devastating," said Homer-Dixon. Furthermore, the probability would be much higher over the proposed ten-year period, starting early next decade, with two flights per month. Since much of the flight time would be spent over some 2,400 kilometers of northern Canada, a crash could very likely occur over land.

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COIFFURE

.. plutonium over Canada

continued from page 5

In such an event, crash-proof containers become essential. Since the plutonium would be in powder as opposed to pellet form, it could easily enter the atmosphere if the ruptured containers came into contact with crash flames. "Depending on the particle size," he said, "the powder could remain airborne for as long as sixty days and travel many miles before being washed out by rain."

Because certain isotopes of plutonium decay into the more radioactive element, americium, the longer plutonium remains in the environment, the more toxic it becomes.

Furthermore, the alpha-radiation emitted by the plutonium on just one flight would be equivalent to about a quarter of the total amount emitted by all past atmospheric nuclear tests combined. And although plutonium is not dangerous if touched or even ingested, Homer-Dixon pointed out that "inhaling even a minute speck can cause cancer."

So far, small-scale casks capable of withstanding a 460 km/h impact have been approved by the U.S. Nuclear Regulatory Commission (NRC). However, much larger casks needed for several hundred kilograms of plutonium are still

being designed and may not be able to survive such an impact.

"Even the best currently-designed casks will not be satisfactory for Canadian conditions because the NRC's standard assumes a crash during take-off or landing," said Homer-Dixon. "If a plane comes crashing down from cruising altitude, the impact could easily exceed 460 km/h."

The sheer volume of plutonium to be transported presents serious security as well as environmental problems. "The amount to be flown over Canada is roughly equal to half the plutonium in the entire U.S. arsenal," said Homer-Dixon. He doubts that diversion of this plutonium for nuclear weapons through terrorism or covert operations poses an immediate threat. However, as the global trade in plutonium increases, so does the chance that such diversion will take place.

Canada may face a more immediate threat to its security. "During the five years of negotiations between the U.S. and Japan, Canada was only advised, not consulted," said Homer-Dixon. In fact, he claims that only portions of the agreement are known to Canadian officials. Furthermore, their lack of concern, he said, "brings into question the government's commitment to protect Canadian northern sovereignty."

Meanwhile, the U.S. Congress is expected to ratify the agreement sometime early next year. Homer-Dixon argues that if Canada does nothing before then, it will be too late. "In terms of Canadian-American relations, the political costs of denying passage of plutonium flights will be too high once the agreement is ratified," he said.

Although Homer-Dixon and others have been urging members of the government to take a closer look at the dangers of plutonium flights, Canada's position, or lack of one, has not changed. When contacted last Thursday, an official at the Department of External Affairs, who preferred to remain anonymous, stated that no definite position will be taken until the agreement is signed by President Reagan.

The official did say that Canada is committed to peaceful nuclear commerce and that safety is of the utmost concern. When asked what would happen to Canada-U.S. relations if Canada refused passage, he said only that he would expect the U.S. to respect that decision.

The opposition, however, does not seem to be buying the government's assurances. Glen O'Crane, executive assistant to Liberal MP and former Environment Minister, Charles Caccia, said "if we advocate plutonium flights now, we give tacit approval to future flights. Let's put a re-negotiation clause into the agreement so that we can pull out at any time."

O'Crane also questions the safety of the flights. "Even one accident can disrupt the fragile arctic environment and the native lifestyle," he said. "If it's that safe, the Americans can fly it over Washington D.C."

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372 — LOST & FOUND

Leather jacket - men's. Lost in Arts 230, Friday, September 11. Black, size 42. London Fog. Call Rob at 398-6791.

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REWARD -- for the person who returns the Walkman headset in the Eaton's bag at the Redpath Library reserve desk (or photocopying room) on the night of Sept 22 1987. Please return it in exchange for ANYTHING else. It is not mine!!! 276-6229.

Nells -- do you have my red jacket? Temple 288-4735.

374 — PERSONAL

Looking for serious prose writers to form an informal writing workshop. If interested call Karen 848-9575.

Need one boy-friday male model. Gentleman weekend farmer, cultivated, wanted for public relations/journalistic landmark. Benefits: Paris défilé, Carnival in Rio, etc... Good-looking, handy and witty a major plus. 861-1064 9:00am - noon, 5:00 - 7:00pm.

The Infertility Clinic, Royal Victoria Hospital, is screening potential donors for the artificial insemination by donor program. If you wish to benefit from the stipend, please contact the director, 842-1231, local 660.

Kappa Kappa Gamma women's fraternity would like to thank all of the girls who have helped make Rush '87 so successful. Three cheers for the Rushees!!! It was great meeting all of you.

383 — LESSONS OFFERED

LSAT/GMAT prep courses for Oct 17 LSAT classes Sept 25, 26, 27, Jan 23 GMAT classes Jan 2, 3. (416) 923-PREP, 1-800-387-1262. We offer courses in Toronto, Ottawa and Montréal. *A full day session

385 — NOTICES

\$200 reward for info leading to the finding & testimony of a witness of a Feb 27/87 assault. This took place in the Undergraduate Library (basement).

Afternoon lows? Come to the Leacock Tea for superb pastry, tea and coffee, and congenial atmosphere. 3 to 5pm, daily. Leacock Bldg. room 304.

Craig Offman - Country & Western rap star performs contemporary social comments -- the Alley, Wednesday, September 30, 9:00pm.

McGill Christian Fellowship. IVCF leadership conference '87. Retreat at Camp Livingstone in the Eastern Townships, Oct 2-4. Call 486-9393. Ask Tom for more info.

C.A. Offman, famous St-Paul's Cathedral organist will be playing guitar not organ at the Alley, Wednesday, September 30, 9:00pm. A Steak Pit Production.

Don't let go of your summer without a fight! Come to the Zeta Psi Beach Party, Friday, October 2nd, 481 Prince Arthur.

387 — VOLUNTEERS

Help those who cannot help themselves!! Volunteer your spare time to help raise funds for the SPCA. Public education and fund-raising work only. If interested call Paul at 277-6154.

Open house for Yellow Door volunteers, Thursday, October 1, 4-6pm. 3625 Aylmer. Welcome.

389 -- MUSICIANS WANTED

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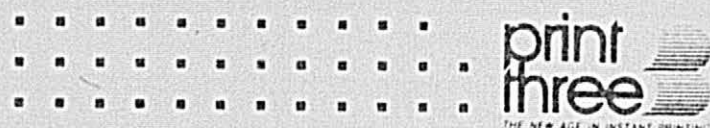
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